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ABSTRACT

A plan was created for organizing and deriving the learning content of a multi-occupational, performance based vocational education (PBVE) Indiana high school auto mechanics program in vehicle repair. Three surveys were conducted. First, 498 businesses were surveyed to determine existing vehicle repair job titles in Indiana and ways to group these job titles. A second survey was sent to 699 businesses to determine the number of persons employed in each job title identified. The last survey, a task inventory instrument, was mailed to a stratified sample of 198 employers of eight selected job titles. There were four major findings. First, there were 148 job titles identified in the areas of auto, light duty, and medium duty vehicle repair; heavy duty vehicle repair; auto and truck body repair; and small engine repair. In view of this, the generic term auto mechanics includes many job titles for which students can be specifically trained. Second, a PBVE program plan was developed and represented in a job title matrix in which job titles are organized by common tasks. The matrix is used as the basis for program organization and learning content derivation. Third, a task inventory and system for identifying common tasks among job titles was developed. Last, a learning module development process was devised for teaching and learning content. (Sample pages from the three survey forms are appended.) (EM)

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ED154244

INFORMATION SERIES

Number Four

A Project Report

A PLAN TO ORGANIZE PERFORMANCE BASED AUTO MECHANICS PROGRAMS AND DERIVE LEARNING CONTENT

written by

Bill R. West

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U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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ABSTRACT

Problem

The purpose of this study was to design a process which would (a) facilitate the administrative structuring of programs designed to prepare students at Carmel High School, Carmel, Indiana for job titles or clusters of job titles of their choice and (b) provide a way to derive and specify course content. The objectives were to:

1. Develop a multi-occupational, performance based vocational education (PBVE) program plan which would group existing job titles in auto mechanics for the purposes of program organization and curriculum development. (This group of jobs is technically the highway transportation subcluster of the transportation occupations cluster.)

2. Design an administrative structure for delivering a multi-occupational PBVE program for job titles in the auto, light duty, and medium duty vehicle repair cluster.

3. Conduct a task inventory survey of job holders in eight job titles in the auto, light duty, and medium duty vehicle repair cluster.

4. Derive and organize for instruction the learning content of the eight job titles.

5. Devise a process for developing PBVE learning modules.

Procedures

The vehicle repair aspect of the highway transportation subcluster of the transportation occupations cluster was selected for analysis because there are many auto mechanics programs in secondary and postsecondary schools. The industry was first surveyed to determine existing vehicle repair job titles in Indiana and ways to group these job titles based on common areas of work performed. A total of 179 of a possible

498 car dealerships, independent garages, truck fleet owners and dealerships, service stations, body shops, implement dealers, and motorcycle and marine dealerships responded (35.9 percent). The job titles were grouped into related categories and a clustering plan or matrix was developed.

A second survey was conducted to determine the number of persons employed in each job title identified. A total sample of 699 businesses were mailed questionnaires and 236 responded (33.8 percent). From this data the sample size for the task inventory survey was determined.

The third survey, a task inventory instrument, was mailed to a stratified sample of 198 employers of eight selected job titles. A total of 95 companies responded (48 percent). From this data learning content was identified for specific job titles and for groups of related job titles.

A program management plan and a learning module development system were developed for implementing the PBVE plan.

Findings

The major findings of this study were:

1. There were 148 job titles identified in the areas of auto, light duty, and medium duty vehicle repair; heavy duty vehicle repair; auto and truck body repair; and small engine repair. In view of this, the general term *auto mechanics* includes many job titles for which students can be specifically trained.

2. A PBVE program plan was developed and represented in a job title matrix. In it, job titles are organized by common tasks and the matrix is used as the basis for program organization and learning content derivation.

3. A task inventory and system for identifying common tasks among job titles was developed.

4. A learning module development process was devised for teaching learning content.

ACKNOWLEDGEMENTS

A project of this scope requires the concerted efforts, imagination, and understanding of many people. The project director and principal investigator would like to commend the State Board of Vocational and Technical Education for its foresight in anticipating the contribution such an investigation might make to better vocational programming in Indiana. We also express our appreciation to Mr. Don K. Gentry, Executive Officer/State Director and Mr. Edgar Hornback, Coordinator of Research and Exemplary Programs, State Board of Vocational and Technical Education for their leadership in performance based vocational education.

Finally, a word of thanks and appreciation to Dr. Robert Hartman, superintendent of Carmel Clay Schools, for his support and encouragement of this project.

B.R.W.
D.B.

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION 1

Background 1
The Problem 2
Objectives 2
Report 3

CHAPTER II: PROCEDURES 5

Matrix Development 5
Survey One--Job Title Identification 5
Survey Two--Employment Patterns in Job Titles 7
Survey Three--Task Inventory 9

CHAPTER III: FINDINGS 15

The Matrix--A Process Plan 15
Details of the Matrix Components 19
Administrative Rationale for Program Organization with the Matrix Plan 23
A Method for Deriving Learning Content with the Matrix Plan 27

CHAPTER IV: CONCLUSIONS AND RECOMMENDATIONS 33

Summary 33
Conclusions 33
Recommendations 34

APPENDICES 35

APPENDIX A: Sample Pages of Survey One: Identification of Job Titles in Highway Transportation 35

APPENDIX B: The Multi-Occupational PBVE Program Matrix for the Auto Mechanics Cluster of Job Titles . . 38

APPENDIX C: Sample Pages of Survey Two: Employment Patterns in Job Titles 44

APPENDIX D: Sample Pages of Survey Three: Task Inventory . . 45

APPENDIX E: Advisory Committee 49

BIBLIOGRAPHY 51

REPORT TITLES 52

LIST OF TABLES

Number	Title	Page
1	STRATIFICATION OF VEHICLE REPAIR EMPLOYERS AND RATE OF RESPONSE TO THE JOB TITLE QUESTIONNAIRE (SURVEY ONE)	6
2	STRATIFICATION OF 58 JOB TITLES AND RATE OF RESPONSE TO EMPLOYMENT PATTERNS QUESTIONNAIRE (SURVEY TWO)	7
3	STRATIFICATION OF TASK INVENTORY (SURVEY THREE) BY CITY SIZE AND LOCATION IN THE STATE	8
4	DISTRIBUTION OF 160 TASK INVENTORY INSTRUMENTS (SURVEY THREE) BY CITY AND KIND OF NEW CAR DEALERSHIP	10
5	NUMBER OF COMPANIES WHICH EMPLOY PERSONS IN EIGHT JOB TITLES AND NUMBERS OF PERSONS THEY EMPLOY, DISTRIBUTED BY TYPE OF COMPANY AND JOB TITLE (SURVEY THREE)	12
6	NUMBER OF RESPONDING COMPANIES WHICH EMPLOY PERSONS WITH JOB TITLES IN FOUR DIVISIONS . . .	20

LIST OF FIGURES

Number	Title	Page
1	THE BASIC MATRIX--A PROCESS PLAN FOR ANALYSIS OF JOB TITLES AND TASKS	16
2	A SAMPLE PORTION OF THE APPLIED MATRIX FOR AUTO MECHANICS	17
3	A PLAN FOR ORGANIZING AND IMPLEMENTING AN OPEN-ENTRY, OPEN-EXIT, PERFORMANCE BASED PROGRAM	26
4	SAMPLE INFORMATION FROM TASK INVENTORY WITH WHICH TO DERIVE CORE LEARNING CONTENT FOR EIGHT JOB TITLES, BY FREQUENCY OF PERFORMANCE AND AVERAGE TIME SPENT ON TASK	28
5	A PROCEDURE FOR DEVELOPING PERFORMANCE BASED LEARNING MODULES	30

CHAPTER I

INTRODUCTION

Background

As a result of the 1968 and 1972 amendments to the Vocational Education Act of 1963 the goals of vocational education have expanded to serve greater numbers of people who have a wider range of occupational goals and educational needs. The act indicates that persons of all ages should have ready access to vocational training or retraining in light of actual or anticipated opportunities for gaining employment. This training should be suited to students' needs, interests, and abilities.

Although federal legislation clearly intends that vocational education serve *all* persons in terms of their interests and abilities, this will be difficult to achieve because it will require that program organization be very flexible and that learning content be job title specific. The traditional blocking of time in large segments so as to give all students the same instructional prescription has prevented programs from being student-centered and has effectively closed the door on hundreds of prospective students whose schedules could not accommodate it. New programs must be able to equip students for future job mobility by giving them a broad base of training options.

A survey of the students at Carmel High School, Carmel, Indiana (1974) indicated that 90 percent of them desired occupational preparatory experiences for the world of work, ranging from training for a single entry-level job to preparation for a broad career. Some students enter the world of work after graduation from high school, some need job skills for supplemental employment while in school, others drop out of college and need salable skills to enter the working world at an appropriate level, and some seek broad job cluster preparation which will allow for greater employment opportunities and mobility.

Students desiring to acquire occupational skills have unique educational needs which require innovative programming. As Frantz (1975) points out, "The diversity of students enrolled in high school vocational education programs requires a

flexible and personalized approach to the delivery of instruction if the goal of providing students with options is to be realized."

The Problem

There are three basic realities that vocational education planners must consider:

1. Vocational education courses will continue to enroll students who have diverse career goals.

2. Vocational education students possess a wide range of learning strengths and abilities.

3. Enrollees will enter courses with wide variety of previous learning experiences and motivations which affect the duration and the nature of their training.

In view of these realities, programs should allow learners' goals, objectives, and time requirements to vary within and among occupational clusters. However, it is often true that traditional vocational programs organize their time schedules into blocks and their learning content into inflexible courses which do not accommodate individual needs. The problem is a great challenge to the field of vocational education.

In an effort to meet this challenge, this project has created a plan for organizing and deriving learning content for a multi-occupational, performance based vocational education (PBVE) auto mechanics program. The plan uses a job title or cluster of job titles as the program's basic instructional goal. It is designed to provide the flexibility necessary to reach larger numbers of students who have a broad range of abilities and interests.

Objectives

The goal of this project was to design a process which would (a) facilitate the administrative structuring of programs designed to prepare students at Carmel High School, Carmel, Indiana for a job title or clusters of job titles of their choice and (b) provide a way to derive and specify course content. The objectives were to:

1. Develop a multi-occupational, performance based vocational education (PBVE) program plan which would group existing job titles in auto mechanics for the purposes

of program organization and curriculum development. (This group of jobs is technically in the highway transportation subcluster of the transportation occupations cluster.)

2. Design an administrative structure for delivering a multi-occupational PBVE program for job titles in the auto, light duty, and medium duty vehicle repair cluster.

3. Conduct a task inventory survey of job holders in eight job titles in the auto, light duty, and medium duty vehicle repair cluster.

4. Derive and organize for instruction the learning content of the eight job titles.

5. Devise a process for developing PBVE learning modules.

Report

This report will include:

1. A description of the following three surveys which were conducted to gather data for developing a job title matrix:

   Survey One: To identify the existing vehicle repair job titles in Indiana and ways to group these job titles based on common areas of work performed.

   Survey Two: To determine the number of persons employed in each job title identified.

   Survey Three: To conduct a task inventory to be used to derive learning content for each job title and for groups of related job titles.

2. A description of the matrix plan--a process whereby job titles, which are verified by industry, are classified into task related groups which are useful for structuring flexible PBVE programs and for deriving course content.

3. A description of a way to identify common tasks among eight job titles which can facilitate course organization in PBVE programs.

4. A description of a process for developing learning modules which can be used for teaching learning content.

CHAPTER II

PROCEDURES

Matrix Development

The most essential undertaking of this project was to analyze and group job titles in auto mechanics (i.e., the highway transportation subcluster of the transportation occupations cluster). An advisory committee was appointed to assist the researchers in this task. The field of investigation was restricted to the vehicle repair aspect of this subcluster because there are many auto mechanics programs in secondary and postsecondary schools. Various occupational clustering plans were studied and evaluated in light of the objectives of this project. Since none was considered adequate for this study, a new clustering plan, called a matrix plan, was developed for deriving multi-occupational PBVE curriculum content and for organizing programs in an open-entry, open-exit system.

Survey One--Job Title Identification

First Sample Selection

The analysis process began with a survey to determine existing vehicle repair job titles in Indiana. First, the population was defined as those companies engaged in the repair aspect of highway and specified off-highway vehicles, all-terrain vehicles, and utility equipment and conveyances. Names of businesses were secured from mailing lists supplied by the Indiana Motor Truck Association, Indiana Auto Dealers Association, Indiana Gas Dealers Association, Indiana Automotive Engine Rebuilders Association, Independent Garage Owners Association, and the Indiana Implement Dealers Association. A mailing list of motorcycle and marine dealerships was developed from the yellow pages of telephone directories in the northern and central sections of Indiana. Northern Indiana was selected because of the marine industries located near Lake Michigan. The advisory committee considered central Indiana to be sufficiently representative of the motorcycle industry. The sample of 498 was drawn from this total statewide population of 1,657, and was stratified by type of business to yield the greatest possible

variety of job titles which belong in this occupational sub cluster: (1) new and used car dealerships, (2) independent garages, (3) truck fleet owners and dealerships, (4) service stations, (5) body shops, (6) implement dealers, and (7) motorcycle dealerships.

First Data Collection

A survey instrument was locally field tested and then mailed to the 498 businesses, and a total of 179 returns were received for an overall response rate of 35.9 percent (Table 1). The advisory committee determined the numbers sent to each group on the basis of employment opportunities in the field. They judged that the largest group employing auto mechanics is new and used car dealerships; so the greatest number of questionnaires were sent to them. Implement dealers were heavily sampled because this group employs the greatest number of small engine mechanics.

In the questionnaire respondents were asked to (1) indicate on a list the vehicle repair job titles which they employed, (2) add any vehicle repair job titles used which the survey omitted, and (3) check the appropriate column(s) describing each job holder's broad area of work. These survey results became a data base for grouping job titles into the occupational matrix. Sample pages of this questionnaire are in Appendix A.

TABLE 1: STRATIFICATION OF VEHICLE REPAIR EMPLOYERS AND RATE OF RESPONSE TO THE JOB TITLE QUESTIONNAIRE (SURVEY ONE)

	Stratified random sample		*Usable returns*	
Type of Business	*n*	%	*n*	%
New and used car dealerships	203	40.8	60	29.6
Independent garages	58	11.7	18	31.0
Truck and fleet dealerships	32	6.4	17	53.1
Service stations	19	3.4	5	26.3
Body shops	41	8.2	9	21.9
Implement dealers	98	19.7	57	58.1
Motorcycle and marine	47	9.4	13	27.7
TOTAL	498	99.6	179	35.9

First Data Analysis

The data were analyzed by counting the simple frequency of companies which employed persons for each job title and comparing and verifying the employers' assignments of job titles to work areas. This resulted in the establishment of the first four dimensions of the matrix: division, category, subcategory, and job title (Appendix B).

Survey Two--Employment Patterns in Job Titles

Second Sample Selection and Data Collection

A second data collection instrument was developed to determine numbers of persons employed in each job title in various types of businesses. The sample was drawn from 1424 members of the associations used in the first survey and the questionnaire was locally field tested. A total sample of 699 businesses were surveyed to determine employment patterns in the 58 identified job titles. There were 236 responses for a rate of 33.8 percent (Table 2). The instrument was distributed as follows:

250 of 258--members of the Independent Garage Owners Assoc.

160 of 387--members of the Indiana Gas Dealers Assoc.

54 of 56--members of the Indiana Automotive Engine Rebuilders Assoc.

70 of 71--members of the Indiana Motor Truck Assoc.

165 of 652--members of the Indiana Auto Dealers Assoc.

699 1424

TABLE 2: STRATIFICATION OF 58 JOB TITLES AND RATE OF RESPONSE TO EMPLOYMENT PATTERNS QUESTIONNAIRE (SURVEY TWO)

	Stratified random sample		*Usable returns*	
Type of Business	*n*	%	*n*	%
Auto machine shops	54	7.7	21	38.0
Independent garages	250	35.8	87	34.0
Motor truck	70	10.0	31	44.0
Service stations	160	22.9	45	28.0
New and used car dealers	165	23.6	52	31.0
TOTAL	699	100.0	236	33.8

The advisory committee and researchers judged that service station and car dealership job holders organize their work more like one another than do the other groups sampled; therefore, instruments were not mailed to all of them. Questionnaires were sent to an equal number of American Motors, Ford, Chrysler, and General Motors dealerships.

The questionnaire was mailed to the employers chosen for the study, asking the business owners or supervisors to indicate what number of persons in the business were employed in each job title. They were directed to assign an employee the job title on which s/he spent the greatest amount of time and to count each person only once.

Thus, the second survey identified the numbers of persons employed in each of 58 job titles identified in the first survey. The results became a data base for determining sample size of a third survey of the tasks performed by job title holders. See sample pages of this questionnaire in Appendix C.

Second Data Analysis

These data were analyzed by a simple frequency count of persons employed in each job title by type of business.

TABLE 3: STRATIFICATION OF TASK INVENTORY (SURVEY THREE) BY CITY SIZE AND LOCATION IN THE STATE

City size	*n*	*North-east*	*North-west*	*South-west*	*South-east*	*Central*
125,000-75,001	6	2	2	1	0	1
75,000-40,001	9	1	2	2	0	4
40,000-20,001	11	1	5	0	3	2
20,000-7,001	44	8	10	6	6	14
7,000-4,001	38	7	6	6	8	11
TOTALS	108	19	25	15	17	32

n Number of cities in each category.

Survey Three--Task Inventory

Third Instrument

After a study of available inventories, the task inventory instrument was developed on the basis of the validated auto mechanics instrument and task list developed at The Ohio State University (1973). To this list were added tasks identified through interviews with holders of job titles. The advisory committee reviewed and approved the final task inventory form.

The instrument asked the respondent: (1) Do you perform a given task? and (2) How much time do you spend performing the task? A sample page is in Appendix D.

Third Data Collection

The eight job titles selected for analysis were automatic transmission specialist, battery-generator-starter-alternator-regulator specialist, engine tune-up specialist, engine overhaul specialist, heavy line mechanic, parts person, light line mechanic, and hydraulic brake specialist. The inventory instrument was mailed according to three criteria:

1. Five sections of Indiana were sampled: northeast, northwest, central, southeast, and southwest.
2. Cities were sampled by five population strata: 4,000-7,000; 7,001-20,000; 20,001-40,000; 40,001-75,000; and 75,001-125,000.
3. New car dealerships were sampled by auto make, including foreign car retailers.

A total of 499 task inventory instruments were distributed by mail to 198 businesses in 108 cities; there were 95 responses (48 percent). Table 3 presents the stratification by city size and location in the state. Table 4 presents the distribution of inventory to dealerships according to city and kind of new car dealership.

Each company was mailed one inventory for each job title it reported on Survey Two. Table 5 presents the number of companies which employ persons in eight job titles and numbers of persons they employ as they are distributed by job title and type of business. The results from the task inventory, i.e., frequency of performance and average time spent on tasks,

ABLE 4: DISTRIBUTION OF 160 TASK INVENTORY INSTRUMENTS (SURVEY THREE) BY CITY AND KIND OF NEW CAR DEALERSHIP

City	GM	Ford	Chry	AMC	Foreign
Angola	1	1			
Auburn	1	1	1		
Attica	1				
Anderson	2		1		
Bedford		1			
Bloomington			1	1	
Bluffton			1		
Booneville				1	
Columbia City		1			
Crawfordsville			1	1	
Columbus	1	1			
Connersville		1		1	
Clinton			1		
Crown Point	1				
Decatur			1		
Edinburg	1				
Elkhart	1			1	1
East Chicago	1				
Evansville	1	2	1		1
Elwood		1			
Fort Wayne	1			1	2
Frankfort		1	1	1	
Franklin				1	
Greenwood		1			
Greencastle	1	1		1	1
Greensburg		1	1	1	
Greenfield			1		1
Gas City	1				
Garrett		1			
Goshen	1				
Gary	2	1	1		1
Huntington			1		
Hobart		1			
Highland					1
Hammond	2		1		
Indianapolis	4	2	2	1	4
Jeffersonville			1		1
Kokomo	1	1	1		1
Kendallville		1	1		
Lawrenceburg	1				
Lafayette	1		1		
LaPorte		1		1	

continued on next page

TABLE 4 *continued*

Lowell			1		
Logansport		1			1
Monticello	1	1			
Muncie	1	1		1	1
Mooresville		1			
Mishawaka		1			
Michigan City				1	1
Marion			1	1	
Madison			1		
Martinsville			1		
New Albany	1		1		
Noblesville		1	1	1	
New Haven		1			
New Castle	1		1		
Princeton			1		
Portland		1			
Plymouth		1	1		
Rushville		1	1		
Richmond	1		1	1	1
Rensselaer		1			
Rochester	1	1	1		
South Bend	1		1		1
Shelbyville		1			
Seymour				1	
Terre Haute	1	1	1	1	
Tell City			1		
Tipton	1	1			
Union City			1		
Valparaiso	1	1	1	1	1
Vincennes	1	1	1		1
Washington	1				
Wabash		1			
Warsaw	1	1			
TOTALS *(total=160)*	40	40	38	21	21

became a data base for deriving core learning content for teaching specific job titles and groupings of job titles.

Data Analysis

The data were analyzed to determine:

1. The percent of respondents of each job title who performed each task:

TABLE 5: NUMBERS OF COMPANIES WHICH EMPLOY PERSONS IN EIGHT JOB TITLES AND NUMBERS OF PERSONS THEY EMPLOY, DISTRIBUTED BY TYPE OF COMPANY AND JOB TITLE (SURVEY THREE)

Employee by Job Title / *Employer by Company Type*	*Total Employees*	Auto Dealers b=45		Gas Dealers b=42		Auto Machine Shops b=16		Indep. Garages b=71		Motor Trucking Companies b=24		Total Employers Sampled b=198	
		a	%	*a*	%	*a*	%	*a*	%	*a*	%	*a*	%
			c		*c*		*c*		*c*		*c*		
Automatic Transmission Spec.	71	29	*64*	4	*10*	-	-	9	*13*	4	*17*	46	*23*
			41		7		-		17		6		
Battery-Gener.-Starter-Alter.-Regulator Spec.	151	17	*38*	21	*50*	2	*13*	25	*35*	7	*29*	72	*36*
			40		44		2		52		13		
Engine Overhaul Specialist	144	23	*51*	5	*11*	5	*31*	17	*24*	11	*46*	61	*31*
			45		13		11		29		46		
Engine Tune-up Specialist	216	24	*53*	33	*79*	1	*6*	23	*32*	9	*38*	90	*45*
			54		65		2		66		29		
Hydraulic Brake Specialist	106	11	*24*	13	*31*	-	-	16	*23*	3	*13*	43	*22*
			28		24		-		42		12		
Light Line Mechanic	153	22	*49*	16	*38*	1	*6*	16	*23*	8	*33*	63	*32*
			54		36		3		37		23		
Heavy Line Mechanic	239	25	*56*	4	*10*	-	-	11	*15*	21	*88*	61	*31*
			49		6		-		17		167		
Parts Person	276	42	*93*	4	*10*	13	*81*	18	*25*	12	*50*	89	*45*
			94		14		114		27		27		

Note: This report analyzes only those job titles which are part of the matrix. There was another job title (general mechanic) in the survey which does not appear on this table. Hence, the totals shown here are less than those reported in the text for this survey.

[a] Number of task inventory surveys sent, i.e., *one* survey to each *company employer* which uses each job title (as per Survey Two results) regardless of number of employees under that title.

% Percentage of companies which employ persons in job title.

[b] Number of companies sampled in each business category.

[c] Number of *employees* in each job title by business type.

$$\frac{IP}{IR} \times 100$$

Where, IP: number of job holders performing the task
IR: total number of job holders responding

2. The averaged amount of time spent on each task by each responding employee who performed the task:

$$\frac{\Sigma x_i}{IP}$$

Where, x_i: average amount of time (more or less on a scale of 7-1) assigned to each task by the performing employee
IP: number of job holders performing the task

CHAPTER III

FINDINGS

The three surveys conducted by this project--the job title identification survey, employment in job titles survey, and task inventory survey--produced a data base and organization plan with which educators can develop a multi-occupational PBVE program in auto mechanics. More specifically, the project has used information gathered in these surveys to develop a process whereby job titles which have been verified by industry are organized into task related groups which are useful for (1) structuring flexible PBVE programs and (2) deriving course content. The process is called a matrix plan because all of the data and organization components are represented in a matrix arrangement.

The Matrix--A Process Plan

The matrix plan provides a process for analyzing actual occupations and organizing them into clusters so that multi-occupational PBVE can be developed and implemented. The plan was designed to provide (1) a data base and a system for administratively structuring multi-occupational PBVE programs and (2) a process for deriving and organizing learning content for efficient instruction.

Description of Matrix Components--The First Half

The four components which make up the first half of the matrix identify the basic groupings and subgroupings of related repair work *job titles* in auto mechanics. They include: *I. Division* (similar to vocational programs), *II. Category* (similar to specific curricula within programs), *III. Subcategory* (similar course offerings), and *IV. Job Title* (smallest administrative units of instruction). These components provide a basic job title classification scheme for curriculum development. These four matrix components are the basis for a program organization plan. Figures 1 and 2 illustrate the basic matrix plan.

The components for this first half of the matrix were validated in a survey of industry which asked companies to identify the job titles of their employees and to identify the broader

FIGURE 1: THE BASIC MATRIX--A PROCESS PLAN FOR ANALYSIS OF JOB TITLES AND TASKS

PLAN FOR PROGRAM ORGANIZATION				DERIVATION OF LEARNING CONTENT			
I	II	III	IV	V	VI	VII	VIII
DIVISION	CATEGORY	SUBCATEGORY	JOB TITLE	TASK	SUBCATEGORY CORE	CATEGORY CORE	DIVISION CORE
Major groupings of job titles *similar to vocational programs*	Second-level groupings of job titles *similar to specific curricula*	First-level groupings of job titles *similar to course offerings*	List of all job titles *smallest administrative units of instruction*	List of tasks for each JOB TITLE (IV)	Tasks common to job titles in SUBCATEGORY (III)	Tasks common to job titles in CATEGORY (II)	Tasks common to job titles in DIVISION (I)

Note: The matrix plan produces an organizational base and a data base for multi-occupational performance based vocational education (PBVE) program and curriculum development. It provides a process for organizing programs and for deriving learning content.

FIGURE 2: A SAMPLE PORTION OF THE APPLIED MATRIX FOR AUTO MECHANICS

PLAN FOR PROGRAM ORGANIZATION				DERIVATION OF LEARNING CONTENT			
I	II	III	IV	V	VI	VII	VIII
DIVISION	CATEGORY	SUBCATEGORY	JOB TITLE *	TASK	SUBCATEGORY CORE	CATEGORY CORE	DIVISION CORE
AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR	HEAVY LINE REPAIR	ENGINE SYSTEM	Engine overhaul specialist	List of tasks	Tasks common to ENGINE SYSTEM	Tasks common to HEAVY LINE REPAIR	Tasks common to AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR
			Valve train specialist	List of tasks			
			Automotive machinist	List of tasks			
			Lubrication system specialist	List of tasks			
		DRIVE TRAIN SYSTEM	Differential specialist	List of tasks	Tasks common to DRIVE TRAIN SYSTEM		
			Automatic transmission specialist	List of tasks			
			Clutch specialist	List of tasks			
			Drive shaft repair specialist	List of tasks			
	LIGHT LINE REPAIR	BRAKE SYSTEM	Hydraulic brake specialist	List of tasks	Tasks common to BRAKE SYSTEM	Tasks common to LIGHT LINE REPAIR	
			Brake shoe liner	List of tasks			
			Pneumatic air brake specialist	List of tasks			
			Brake machinist	List of tasks			
		ELECTRICAL SYSTEM	Engine diagnostic specialist	List of tasks	Tasks common to ELECTRICAL SYSTEM		
			Engine tune-up specialist	List of tasks			
			Power accessory specialist	List of tasks			
			Air conditioning specialist	List of tasks			

* Job titles listed here represent only a sample of jobs in these subcategories; indeed, this figure shows a sample from a larger matrix for the Highway Transportation Subcluster.

job classifications into which the titles fit (Survey One). The survey identified 160 job titles in four main divisions: 53 job titles in the auto, light duty, and medium duty vehicle repair division; 50 in the heavy duty vehicle repair division; 29 in the truck and auto body repair division, and 28 in the small engine repair division. Table 6 shows the main divisions into which the job titles fit and the numbers of responding companies which employ persons for those titles (West & Brannock, 1976). It should be noted that the term *specialist* is used in job titles throughout this report in order to avoid sex stereotyping, even though the term is somewhat misleading and inaccurate. It is assumed that to be properly called a *specialist*, one must have time on the job.

Based on the survey results, these four divisions were further divided into basic occupational groupings called categories and subcategories according to common tasks performed; then the complete list of job titles was matched with the proper subcategories as shown in Appendix B.

Thus, because the matrix of job titles generated to define the auto mechanics job cluster is based on actual jobs in Indiana industries, it serves as a strong organization base for curriculum development. The organization of the matrix facilitates the administrative structuring of flexible multi-occupational PBVE training programs at the secondary and postsecondary (not baccalaureate) levels. Because job titles are grouped into larger clusters according to similar tasks performed in several jobs, the matrix helps schools eliminate costly repetition of content at various levels, and it provides students with career planning flexibility. Specifically, these first four components of the matrix offer a basic classification scheme which provides for:

1. Administrative flexibility and feasibility.
2. Open-endedness to add new or emerging occupations.
3. Grouping of job titles by tasks performed and job skills required.
4. Grouping of job titles by place of performance.
5. Task identification by job title.
6. Core competency identification.
7. Assigning job titles to mutually exclusive categories.

Description of Matrix Components--The Second Half

Whereas the first four components of the matrix--*division, category, subcategory,* and *job title*--provide a basis for

administrative organization of vocational education programs, the last four components of the matrix--*task*, *subcategory core*, *category core*, and *division core*--provide a basis for specifying the tasks that make up the learning content of vocational curricula.

The four components which make up the second half of the matrix identify the basic groupings and subgroupings of core tasks to be learned for jobs in vehicle repair businesses. They include: *V. Task* (lists of tasks performed for each *job title*), *VI. Subcategory Core* (tasks common to job titles in *subcategory*), *VII. Category Core* (tasks common to job titles in the *category*), *VIII. Division Core* (tasks common to job titles in the *division*). These four components provide the rationale and framework for deriving learning content to match job title clusters; thus, they facilitate curriculum development. See Figures 1 and 2.

The matrix components for this second half of the matrix rely on information derived from a survey of industry (Survey Three). This survey was a task inventory which asked companies to identify the tasks performed in each job and the relative amount of time spent at each task. The survey results were used to compile a list of tasks for each job title. This forms a data base for curriculum developers who can analyze these tasks and determine performance objectives. They can then group the learning content of the curriculum into cores which correspond to the *subcategory*, *category*, and *division* clusters of *job titles* in the first half of the matrix.

Details of the Matrix Components

Division and Division Core

The matrix component called *division* is similar to what vocational educators usually call programs. This project identified four main divisions of job titles in auto mechanics. Since programs are very large administrative units of curricula, rarely would beginning students attempt to prepare for every job title in a division. Students usually begin in more specialized areas, such as a subcategory.

However there are many tasks and learning experiences at the division level which are common to many or most of the job titles in the occupational group each represents. The *division core* component contains the core learning content which must be known by all workers in an occupational cluster, regardless of job title. Some of this content could be organized into general core courses in which students could explore the

TABLE 6: NUMBER OF RESPONDING COMPANIES WHICH EMPLOY PERSONS WITH JOB TITLES IN FOUR DIVISIONS

Division: AUTO, LIGHT DUTY, AND MEDIUM DUTY VEHICLE REPAIR *a=83*

Job Title	*c*
Engine overhaul spec.	57
Short block spec.	29
Valve train spec.	25
Automotive machinist	7
Engine machinist	5
Heavy line mechanic	61
Cooling & lub. system spec.	31
Overdrive spec.	8
Differential spec.	26
Manual transmission spec.	24
Automatic transmission spec.	28
Clutch spec.	21
Transaxle spec.	4
Drive shaft repairer	15
Hydraulic brake spec.	24
Brake shoe reliner	17
Brake machinist	12
Light line mechanic	61
Front end spec.	57
Wh. bearings, tire & wh. bal.	50
Steering & suspension spec.	50
Engine diagnostic spec.	52
Engine tune-up spec.	60
Battery-generator-starter-alternator-regulator spec.	49
Elec'l. wiring harness & diag'm.	41
Power accessory spec.	20
Air conditioning spec.	50
Core repairer	11
Emission control spec.	27
Exhaust system installer	46
Fuel & air system spec.	26
Shop foreman	33
Service manager	44
Quality control inspector	7
Estimator	19
Parts manager	41
Lubrication spec.	70
Dispatcher	16
Car-jockey or clean-up	32
Service writer	26
Parts & accessories sales	20
Service salesperson	13
Parts person	35
Cooling system service person	35
Welder	16
General mechanic	8
Clean-up person	22
New car spec.	1
Parts driver	1
Service director	11
Auto mechanic	1
Frame spec.	1
Manual, auto. trans. & clutch	1

Division: HEAVY DUTY VEHICLE REPAIR *a=17*

Engine overhaul spec.	8
Short block spec.	3
Valve train spec.	3
Automotive machinist	1
Engine machinist	1
Heavy line mechanic	11
Overdrive spec.	1
Manual transmission spec.	6
Automatic transmission spec.	3
Clutch spec.	5
Drive shaft repairer	2
Light line mechanic	3
Hydraulic brake spec.	2
Pneumatic air brakes spec.	4
Brake shoe reliner	2
Front end spec.	4
Wh. bearings, tire & wh. bal.	4
Steering & suspension spec.	3
Battery-generator-starter-alternator-regulator spec.	7
Elec'l. wiring harness & diag'm.	7
Power accessory spec.	6
Air conditioning system spec.	3
Cooling system service spec.	1
Cooling & lub. system spec.	4
Lubrication spec.	6
Engine tune-up spec.	3
Exhaust system installer	4
Fuel injection spec.	3

Pump & injector spec.	4
Supercharging & turbocharging	3
Governor spec.	2
Fuel & air system spec.	4
Shop foreman	11
Service manager	7
Quality control inspector	1
Parts manager	8
Car-jockey or clean-up	2
Service writer	1
Parts & accessories sales	22
Estimator	2
Parts person	7
Emission control spec.	0
Radiator & heater core repairer	0
Brake machinist	0
Differential spec.	4
Dispatcher	0
Service salesperson	2
Welder	3
General mechanic	2
Service lane mechanic	1

Division: TRUCK AND AUTO BODY REPAIR *ab=69*

Frame & panel straightener	21
Welder	16
Sheet metal stra'tener.& cutter	19
Dent filling spec.	15
Fiberglass spec.	13
Auto body maintenance spec.	8
Upholstery & weatherstrip spec.	3
Convertible top, fabric roofs, woodgrain spec.	2
Hardware spec.	6
Glass installer	11
Trim spec.	4
Metal preparer	14
Sanding spec.	14
Paint matching spec.	12
Masking spec.	12
Painter	23
Estimator	19
Parts manager	10
Shop foreman	1
Parts person	11
Clean-up person	1
Body person	3
Combination body & paint	1
Body shop manager	1
Line body person	1
Water leaks & weatherstrip	1
Body person's helper	1
General metal person	1
Frame person	1

Division: SMALL ENGINE REPAIR *a=70*

GMC & Mercury cruiser mech.	5
Evinrude & Johnson outboard me.	1
Mercury outboard mech.	3
Chrysler outboard mech.	2
Rigger	3
Glass, wood & fiberglass spec.	5
Boat mech. (jets)	2
Honda motorcycle mech.	4
Kawasaki motorcycle mech.	2
Yamaha motorcycle mech.	0
Indiana motorcycle mech.	0
Harley-Davidson motorcycle me.	3
Suzuki motorcycle mech.	0
Triumph motorcycle mech.	0
BSA motorcycle mech.	0
Small engine mech. (gas)	51
Parts person	54
Service manager	47
Shop foreman	38
Sales person	54
Parts manager	43
Tractor mech. gas & deisel	5
Machinery set up	1
Farm equipment set up	1
Chain saw mech.	1
Farm equipment mech.	1
Service person	1
Light tractor mech.	1

[a] Number of responding companies in this division.

[b] Includes the body repair departments of new car dealerships.

[c] Number of responding companies which use each job title.

occupational group or it could be introduced as prerequisite basic skills and broad knowledges essential to the group. A school might develop a *division core* prevocational or industrial arts curriculum and a supportive career education curriculum in the middle school from which students could articulate to any of several subcategory levels. The core skills and core knowledge learned from this *division core* curricula at the preparatory level could transfer to whatever specific job title curricula students would choose in a vocational program. Using this plan, there would be less costly repetition of course content at various levels and students would have greater career planning flexibility. See Figures 1 and 2 for illustrations of the matrix plan and Appendix B for the complete auto mechanics matrix.

Category and Category Core

The matrix component called *category* is a smaller grouping of job titles and is similar to specific curricula in school programs. This project identified three or four categories for each division of job titles in auto mechanics (Appendix B). Because the job titles in each category are more closely related to one another than in the division component, there are more common core knowledges, tasks, competencies, and work locations among them.

The *category core* learning content is less specialized than training programs for specific job titles must be; therefore, its skills and knowledges could transfer easily among job titles. According to this matrix plan, this core content could prepare students for a more general group of job titles and could enable them to later make or change their specific career goals within categories without losing training time.

Subcategory and Subcategory Core

The matrix component called *subcategory* is similar to the courses offered in the school curricula. At this level there are the greatest numbers of common skills and knowledges to be learned. Most frequently students would concentrate on preparing for job titles at this level by learning the content included in the *subcategory core*.

However, according to this plan, if they should later wish to transfer into other subcategories, categories, or even divisions, they could do so because they would have transferable skills and knowledge from their core training. This matrix plan provides maximum flexibility for students and enables vocational education programs to meet a wider range of needs.

Job Title and Task

The most basic matrix components are called *job title* and *task*. Job titles are the smallest administrative units of instruction in a vocational program. The *task* component level is specific. In it is embedded learning/performance content for each job title. According to the matrix plan each job title would be analyzed into the tasks which must be performed and then would be compiled into a task inventory.

Following the plan, the information gathered in the task inventory could then be sorted to determine: (1) which content should be taught in an in-school program, (2) which should be taught in a cooperative program, and (3) which should be excluded from the school's programs.

Then each task could be analyzed (West, 1976) and performance objectives and criterion referenced tests could be written. The objectives would then be grouped into their appropriate *subcategory core*, *category core*, or *division core* of learning content.

Small Engines Repair Division/Category

Because the small engines repair division/category is a smaller occupational group, its matrix has only six components; however it functions the same as an eight-component matrix.

Administrative Rationale for Program Organization with the Matrix Plan

The multi-occupational PBVE matrix plan is designed to provide individuals with the knowledges and skills required for entry into a cluster of occupations. The plan is based on occupational groupings or clusters--such as allied health, business and office, and transportation--within which are lists of job titles. Preparations necessary for these titles range from entry-level positions requiring relatively short training periods to higher level jobs requiring longer training time (but not baccalaureate degrees). Each job title requires competencies which job title holders consider essential to job success; these competencies are specified by a task analysis.

The administrative plan for program organization in the matrix is designed to provide students with multiple options when they make their career decisions and with a flexible program which can meet their individual needs. Students have three options:

1. They can prepare for entry into a single, entry-level job.

2. They can prepare for entry into several related job titles that have some common competencies but do not require sequential preparation.

3. They can specialize in one category of jobs within the cluster or prepare for thorough specialization in one high level job title.

For example, students might enter the auto mechanics program (i.e., highway transportation subcluster) to prepare themselves for the single job of tune-up specialist. Students would proceed through the program, accomplishing the tasks specified for that job until all required tasks were mastered; then they could exit the program. They might do this in a relatively short period of time.

The recommended plan is designed to accommodate students who choose comprehensive programs to prepare themselves not only for several kinds of jobs within the subcluster but also for entrance into the transportation occupation cluster at a higher level. These students would spend a much longer time in preparation for such a complex occupational goal.

A Plan for Organizing and Implementing a PBVE Program

Administrators using this matrix plan might arrange a program similar to the one shown in Figure 3. This program would include exploratory and prevocational activities for grades nine and ten to prepare students for making knowledgeable vocational education choices and to equip them with the skills fundamental for entering occupational training programs. For example, a course in power mechanics or engine systems could be a prevocational prerequisite to a training program for the heavy line mechanic job title.

According to this program students could enter Level I in grades 11 or 12. At that level, students could choose to train for a job title and then exit the program prepared to function in that specific position. Or, students could enter Level II for further training in a one- or two-year program within one or more subcategory. At this level, they could prepare for a more comprehensive cluster of job titles.

If students entered Level II in grade 11, they could even further extend their work and enlarge their competencies in grade 12 in three ways:

1. By acquiring competencies in additional job titles.

2. By participating in cooperative programs to broaden their experiences.

3. By specializing in a larger category of job titles through in-school, area school, or cooperative programs.

Some students might have sufficient background to bypass some objectives. A student's ability to demonstrate competency at a prespecified criterion level is the measure of completion, according to this plan.

If at any level students wished to change to another occupational job cluster, they could do so with minimal backtracking. If secondary and postsecondary institutions used similar multioccupational PBVE organization and content in their programs, the model would allow students to continue their training after graduation without interruption or repetition. Even if both programs were not the same, secondary PBVE graduates could articulate more easily with postsecondary programs because their performance skills could be clearly defined.

The Proposed Advantages of the Matrix Plan

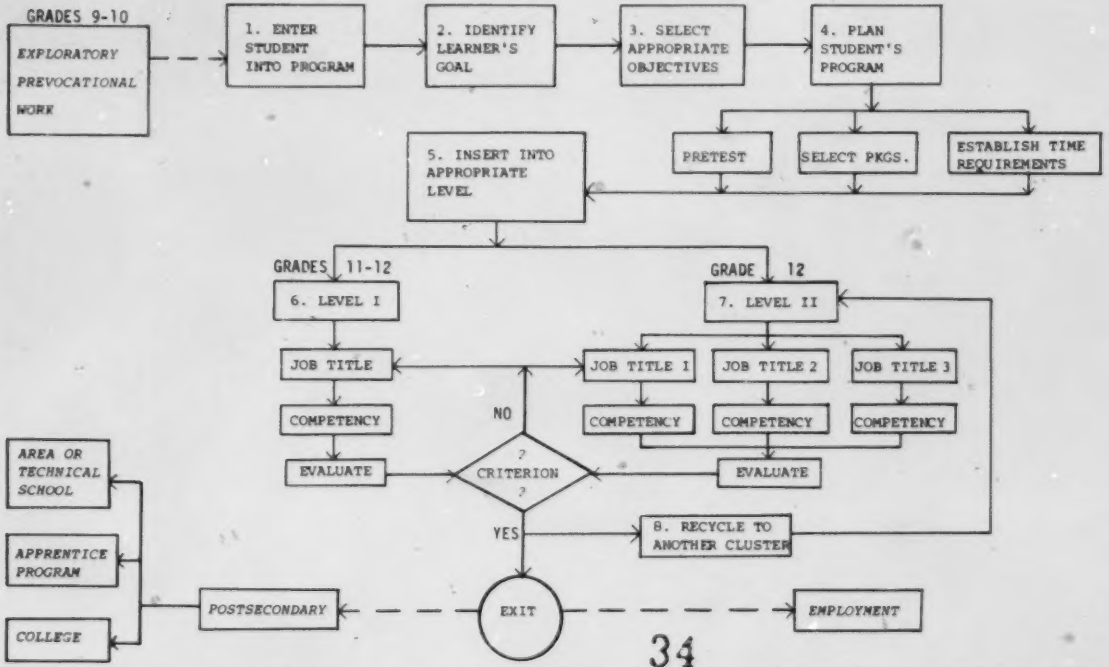
The proposed matrix plan for organizing the structure and learning content of an auto mechanics program offers the following advantages.

1. Students would be able to learn the specific tasks required for the jobs they seek, including the essential background skills and general knowledge they need and excluding unnecessary and costly repetition in their training.

2. Students would be able to exit programs upon learning to perform required tasks, making it possible for programs to serve large numbers of students. Those whose goals do not enable them to spend large portions of their school time in vocational programs could move through quickly. Other students could use this advantage to broaden their course plans to include training in more job titles. In this way, programs could serve a broader range of students.

3. The subcategory and category components of the matrix would facilitate the administrative organization of program areas into smaller and more manageable units. The plan would also provide the basis for facility

FIGURE 3: A PLAN FOR ORGANIZING AND IMPLEMENTING AN OPEN-ENTRY, OPEN-EXIT, PERFORMANCE BASED PROGRAM



and staffing arrangements because it clearly defines training needs.

4. The matrix plan offers a student-centered program because it enables students to choose occupational goals from a wide variety of possibilities.

5. The plan lends itself to evaluation and accountability because of its performance based objectives and prespecified outcomes.

6. The matrix plan could help educators to develop curricula which would expedite students' articulation between programs because the training goals would be defined from analysis of job titles and tasks.

A Method for Deriving Learning Content with the Matrix Plan

Using the Task Inventory Survey Results

The task inventory survey (Survey Three) gathered information with which to derive core learning content for job titles based on the frequency with which those tasks are performed by job holders and on the average time which they spend on those tasks. The eight job titles surveyed represented some that fall in the same subcategory and some that fall in different categories of the matrix. In order to test the matrix plan, tasks which make up the learning content for individual job titles and tasks common to clusters of job titles were identified. A sample of this information about ten tasks is reported in tabular form in Figure 4 to illustrate how learning content can be derived without computer assistance. It is possible to see at a glance which tasks are of significant importance to each job title to be included in curricula and which tasks are common to a cluster of job titles so as to be included in core curricula.

In the figure, the percentage numbers represent the percentage of job title employees who perform each task, according to the survey results. The plain numbers represent the average amount of time (more or less on a scale of 7-1) spent by all responding job titles employees in each category. For purposes of illustrating this method, both kinds of numbers have been rounded off to the nearest whole; however, for greater precision they could be carried out to decimals. It should be noted that the number of respondents in this survey was quite small, so these results are not generalizable. However, they do serve to illustrate the method of learning content derivation.

FIGURE 4: SAMPLE INFORMATION FROM TASK INVENTORY WITH WHICH TO DERIVE CORE LEARNING CONTENT FOR EIGHT JOB TITLES, BY FREQUENCY OF PERFORMANCE AND AVERAGE TIME SPENT ON TASK

Job Titles / *Sample Tasks From Task Statement: PERFORM MAJOR ENGINE REPAIR*	Automatic Transmission Spec. *8*	Battery-Gener.-Starter-Alter.-Regulator Sp. *10*	Engine Overhaul Specialist *8*	Engine Tune-up Specialist *14*	Hydraulic Brake Specialist *6*	Light Line Mechanic *11*	Heavy Line Mechanic *12*	Parts Person *22*
Add water & oil to engine	*38%* 1	*60%* 3	*63%* 3	*57%* 2	*33%* 1	*64%* 3	*100%* 4	*5%* 1
Clean carburator	*38%* 1	*50%* 3	*63%* 2	*79%* 4	*17%* 1	*45%* 2	*67%* 2	
Bore cylinders	*13%* *a*		*25%* 2	*7%* *a*				
Diagnose valve train & head malfunctions	*50%* 1	*40%* 2	*88%* 3	*57%* 2	*17%* 1	*36%* 1	*83%* 3	
Install pistons	*50%* 1	*20%* 1	*100%* 4	*21%* 1	*17%* 1	*27%* 1	*100%* 4	
Grind rocker arm end	*25%* *a*	*10%* 1	*13%* *a*	*21%* 1		*27%* 1	*25%* *a*	
Hone connecting rod & correct bearing fit	*13%* *a*	*10%* 1	*25%* 1	*7%* *a*			*17%* 1	
Inspect/recondition camshaft	*13%* *a*	*20%* 1	*38%* 2				*8%* *a*	*5%* *a*
Inspect/replace camshaft bearings	*50%* 1	*20%* 1	*75%* 3	*21%* *a*		*9%* *a*	*67%* 1	
Machine valve guides for special seals	*25%* *a*		*13%* *a*			*9%* *a*	*8%* *a*	

Note: The *percentage numbers* represent the percentage of job title employees who perform each task, according to the task inventory survey results. The *plain numbers* in the table represent the average amount of time (more or less on a scale of 7-1) spent by all responding job title employees in each category. The *n* in the headings represents the number of respondents in each job title.

[a]Negligible amount (less than 0.5 on a scale of 7-1).

28

With this information from the task survey and with knowledge of students' job title choices and amounts of time they can be enrolled, vocational educators could develop a profile of work for each job title which would include:

1. Estimated training time by job title.

2. Plans for instructional sequences for the year (based on core data).

3. Accommodation of students who are learning common tasks but preparing for different job titles by placing them in the same laboratory with the same teacher.

4. Possibilities for students to enter and exit programs on a flexible time schedule as they satisfy training requirements.

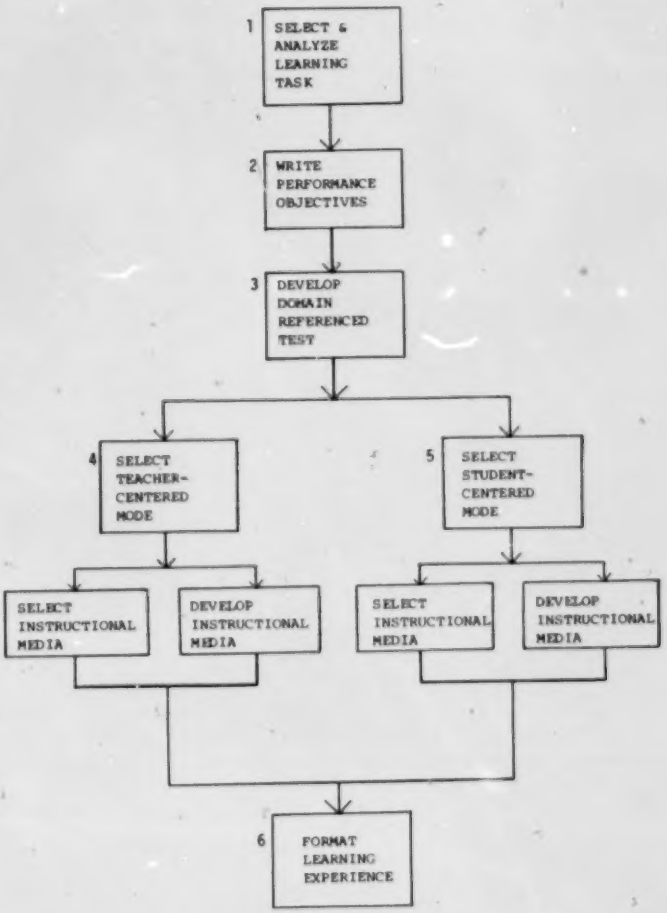
Developing Learning Modules for PBVE Curricula

In order to successfully implement an open-entry, open-exit, multi-occupational PBVE program, appropriate curriculum materials must be developed. The analysis of job titles and tasks provides the learning content for such curriculum materials, and two forms which are suitable for PBVE programs are the learning module and the domain referenced test.

A procedure for producing learning modules and instruments for assessing competence has been developed and included in this plan (Figure 5). The steps in this recommended procedure are:

1. *Select and Analyze Learning Task*. This step is based on a process called task analysis. It identifies the psychomotor capabilities and the analytical, diagnostic, and synthetic cognitive skills necessary to perform tasks and to generalize to other tasks (West, 1976). Later these tasks will be put into a sequence and fit into the curriculum so that the knowledges and skills needed to solve problems can be effectively taught.

2. *Write Performance Objectives*. In this step, task statements are recast into performance objectives. Ususally there are two kinds of objectives necessary: *terminal* (final performance) and *enabling* (or *enroute*, i.e., those which a student must achieve before attempting the terminal objective). Many of the enabling objectives include cognitive skills which are essential to task performance and are generalizable to other tasks.



Source: West, 1976

FIGURE 5: A PROCEDURE FOR DEVELOPING PERFORMANCE BASED LEARNING MODULES

3. *Develop Domain Referenced Tests*. A performance post-test is developed for each terminal and intermediate performance objective either singly or in combination. The criteria used in these tests are industry based, and the tests correspond to both the performance objectives and the learning activities.

4 and 5. *Select Teacher and Student Centered Modes*. Because both methods are suitable in different circumstances and with different teachers and students, it is recommended that teacher-centered and student-centered learning modules be developed. Both should use multi-media and should appeal to as many senses as possible so as to create effective learning experiences.

In the teacher-centered mode, the teacher usually directs the learning activity and students usually progress as a group.

In the student-centered mode, students select from among two or three alternative learning packages (each including the full task objective) and proceed at their individual rates.

Both modes are followed by the same practice and post-test.

6. *Format Learning Experience*. The final step in this procedure is to use the learning module and the results of the task analysis to format the learning experience. This step was patterned after Gagné's seven step hierarchy (1965), and it makes an effort to recognize the various learning levels included in the mastery of a task and to teach each level in its appropriate sequence. The format of the module is similar to the PLACE package introduced by Frantz (1974).

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Summary

The data gathered in the three surveys conducted by this project were used as a basis for constructing the job title matrix for auto mechanics. They identified job titles in Indiana, employment patterns in those job titles, and tasks performed in eight of them.

Conclusions

1. There were 148 job titles identified in the areas of auto, light duty, and medium duty vehicle repair; heavy duty vehicle repair; auto and truck body repair; and small engine repair. In view of this, the generic term *auto mechanics* includes many job titles for which students can be specifically trained.

2. The manual identification of common tasks among job titles is a workable way to organize a course to provide for open-entry, open-exit, multi-occupational PBVE programs.

3. The task list for each of the eight job titles surveyed is a representative listing of tasks performed by all job holders; in actual jobs these tasks can vary. Therefore, it is important to develop a flexible instructional system that will accommodate the varied needs of students who are training for different jobs.

4. The results of Survey Three, i.e., the average amount of time spent on each task by each employee and the percentage of employees performing each task, can be useful information for determining course content.

5. It is possible to construct a matrix of job titles organized by common tasks and to use this matrix as

a basis for program organization, learning content derivation, and instructional sequencing.

6. A process was devised for developing learning modules which would be useful for implementing PBVE programs, because they include both teacher and student methods, alternative learning styles, flexible time schedules, and industry-referenced performance guides and measures.

Recommendations

The successful implementation of a multi-occupational PBVE program depends on properly developed curriculum materials. It is recommended that future efforts be made:

1. To prepare mini-domain catalogs of tasks, performance objectives, and criterion-referenced tests for each subcategory in the matrix developed by this project.

2. To develop learning modules for each category in the matrix.

3. To implement a pilot PBVE program to monitor, evaluate, revise, and disseminate this plan to vocational education programs in Indiana.

4. To use the data gathered by this project to develop a curriculum for an open-entry, open-exit, multi-occupational PBVE program in auto mechanics.

5. To adapt for the computer the manual method of identifying tasks common to several job titles. This could be designed to program an instructional sequence for successive quarters or semesters based on specific job titles.

APPENDICES

APPENDIX A

SAMPLE PAGES OF SURVEY ONE:
IDENTIFICATION OF JOB TITLES IN HIGHWAY TRANSPORTATION

1. Write your job title _____

   Name and address of business _____

   _____

2. Place a check mark in the box next to the kind of business in which you work.

   ☐ New & used car dealership ☐ Independent garage

   ☐ Used car dealership ☐ Service station

   ☐ Other (specify): _____

3. Place a check mark in the box next to the number of employees in your shop.

   ☐ 1-5 ☐ 11-15 ☐ above 20

   ☐ 6-10 ☐ 16-20

INSTRUCTIONS

I. Enclosed are four (4) forms: *Forms A, B, C, D.* Each form is designed to gather job title data for a different category of auto or truck repair and service. Please complete the form appropriate for your business.

II. If your business specializes in repairing and servicing:

   A. Auto and light duty vehicles (up to 1½ tons), complete *Form A.*
   B. Medium duty vehicles (gasoline only), complete *Form B.*
   C. Heavy duty vehicles (deisel only), complete *Form C.*
   D. Truck and auto body, complete *Form D.*

APPENDIX A *continued*

III. Follow these steps:

A. Select the appropriate form.
B. Read the first job title. If that job title *does not* exist in your shop, leave the "yes" column blank and go to the next job title.
C. If that job title *does* exist in your shop, place a check mark (✓) in the "yes" columns to the right of the job title to indicate the areas in which the job title holder works.
D. Go to the next job title and repeat B and C above.
E. Add any job titles that exist in your shop that are not listed here and indicate the areas in which these job title holders work.
F. If your shop performs repairs and services in more than one category, complete an appropriate form for each category.
G. Place the completed questionnaire(s) in the enclosed stamped and self-addressed envelope and mail by October 27, 1975.

SAMPLE FORM SAMPLE FORM SAMPLE FORM

JOB TITLE	YES	Engine Block & Valve Train	Electrical	Fuel & Exhaust	Cooling & Air Conditioning	Chassis & Front End	Brakes	Power Train	Hydraulic
1. Emission control sp.									
2. Heavy line mechanic	✓	✓						✓	
3. Power accessory spec.	✓		✓						
4. Lubrication person	✓			✓		✓			
5.									
6.									

FORM A: AUTO AND LIGHT DUTY VEHICLE (up to 1 1/2 tons)

JOB TITLE	YES	Engine Block & Valve Train	Electrical	Fuel & Exhaust	Cooling & Air Conditioning	Chassis & Front End	Brakes	Power Train	Hydraulic
1. Engine overhaul sp.									
2. Short block spec.									
3. Valve train spec.									
4. Automotive machinist									
5. Engine machinist									
6. Engine diagnostic sp.									
7. Heavy line mechanic									
8. Light line mechanic									
9. Engine tune-up spec.									
10. Battery-generator-starter-alternator-regulator spec.									
11. Electrical wiring harness & diagram spec.									
12. Power accessory spec.									
13. Emission control sp.									

APPENDIX B : THE MULTI-OCCUPATIONAL PBVE PROGRAM MATRIX FOR THE AUTO MECHANICS CLUSTER OF JOB TITLES

PLAN FOR PROGRAM ORGANIZATION				DERIVATION OF LEARNING CONTENT			
I	II	III	IV	V	VI	VII	VIII
DIVISION (PROGRAMS)	CATEGORY (CURRICULA)	SUBCATEGORY (COURSES)	JOB TITLE	TASK	SUBCATEGORY CORE	CATEGORY CORE	DIVISION CORE
AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR	HEAVY LINE REPAIR	ENGINE SYSTEM	Engine overhaul specialist	List of tasks	Tasks common to ENGINE SYSTEM	Tasks common to HEAVY LINE REPAIR	Tasks common to AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR
			Short block specialist	List of tasks			
			Valve train specialist	List of tasks			
			Automotive machinist	List of tasks			
			Engine machinist	List of tasks			
			Heavy line mechanic	List of tasks			
			Lubrication system specialist	List of tasks			
		DRIVE TRAIN SYSTEM	Overdrive specialist	List of tasks	Tasks common to DRIVE TRAIN SYSTEM		
			Differential specialist	List of tasks			
			Manual transmission specialist	List of tasks			
			Automatic transmission spec.	List of tasks			
			Clutch specialist	List of tasks			
			Transaxle specialist	List of tasks			
			Drive shaft repair specialist	List of tasks			
	LIGHT LINE REPAIR	BRAKE SYSTEM	Hydraulic brake specialist	List of tasks	Tasks common to BRAKE SYSTEM	Tasks common to LIGHT LINE REPAIR	
			Brake shoe liner	List of tasks			
			Pneumatic air brake specialist	List of tasks			
			Brake machinist	List of tasks			
			Light line mechanic	List of tasks			

APPENDIX B

AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR	LIGHT LINE REPAIR	FRONT END SYSTEM	Front end specialist	List of tasks	Tasks common to FRONT END SYSTEM	Tasks common to LIGHT LINE REPAIR	Tasks common to AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR
			Wheel bearings, tire & wheel balancing specialist	List of tasks			
			Steering & suspension specialist	List of tasks			
		ELECTRICAL SYSTEM	Engine diagnostic specialist	List of tasks	Tasks common to ELECTRICAL SYSTEM		
			Engine tune-up specialist	List of tasks			
			Battery-generator-starter-alternator-regulator specialist	List of tasks			
			Elec'l. wiring harness& diagram s.	List of tasks			
			Power accessory specialist	List of tasks			
			Air conditioning service person	List of tasks			
		HEATING & AIR CONDITIONING SYSTEM	Air conditioning compressor overhauler *	List of tasks	Tasks common to HEATING & AIR CONDITIONING SYSTEM		
			Climate control specialist *	List of tasks			
			Air conditioning diagnostic sp. *	List of tasks			
			Air conditioning installer *	List of tasks			
			Heater diagnostic specialist *	List of tasks			
			Heater core repair person *	List of tasks			
		COOLING SYSTEM	Cooling system specialist	List of tasks	Tasks common to COOLING		
			Core repair person	List of tasks			
		FUEL EXHAUST SYSTEM	Emission control specialist	List of tasks	Tasks common to FUEL EXHAUST SYSTEM		
			Exhaust system installer	List of tasks			
			Fuel and air system specialist	List of tasks			
	SUPPORTIVE OCCUPATIONS	SUPERVISORY	Shop foreman	List of tasks	Tasks common to SUPERVISORY	Tasks common to SUPPORTIVE OCCUPATIONS	
			Service manager	List of tasks			
			Quality control inspector	List of tasks			
			Estimator	List of tasks			
			Parts manager	List of tasks			

** These job titles did not appear on the original matrix but were added later.*

I	II	III	IV	V	VI	VII	VIII
DIVISION (PROGRAMS)	CATEGORY (CURRICULA)	SUBCATEGORY (COURSES)	JOB TITLE	TASK	SUBCATEGORY CORE	CATEGORY CORE	DIVISION CORE
AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES REPAIR	SUPPORTIVE OCCUPATIONS	LOGISTICS & MAINTENANCE	Lubrication person	List of tasks	Tasks common to LOGISTICS & MAINTENANCE	Tasks common to SUPPORTIVE OCCUPATIONS	Tasks common to AUTO, LIGHT DUTY, & MEDIUM DUTY VEHICLES
			Dispatcher	List of tasks			
			Car jockey or clean-up	List of tasks			
			Service writer	List of tasks			
			Parts & accessories salesperson	List of tasks			
			Service salesperson	List of tasks			
			Parts person	List of tasks			
HEAVY DUTY VEHICLES REPAIR	HEAVY LINE REPAIR	ENGINE SYSTEM	Engine overhaul specialist	List of tasks	Tasks common to ENGINE SYSTEM	Tasks common to HEAVY LINE REPAIR	Tasks common to HEAVY DUTY VEHICLES REPAIR
			Short block specialist	List of tasks			
			Valve train specialist	List of tasks			
			Automotive mechanic	List of tasks			
			Engine machinist	List of tasks			
			Heavy line mechanic	List of tasks			
		DRIVE TRAIN SYSTEM	Overdrive specialist	List of tasks	Tasks common to DRIVE TRAIN SYSTEM		
			Manual transmission specialist	List of tasks			
			Automatic transmission spec.	List of tasks			
			Clutch specialist	List of tasks			
			Drive shaft repair person	List of tasks			
	LIGHT LINE REPAIR	BRAKE SYSTEM	Light line mechanic	List of tasks	Tasks common to BRAKE SYSTEM	Tasks common to LIGHT LINE REPAIR	
			Hydraulic brake specialist	List of tasks			
			Pneumatic air brake specialist	List of tasks			
			Brake shoe reliner	List of tasks			
		FRONT END SYSTEM	Front end specialist	List of tasks	Tasks common to FRONT END SYSTEM		
			Wheel bearings, tire & wh. balancing	List of tasks			
			Steering & suspension specialist	List of tasks			

APPENDIX B

HEAVY DUTY VEHICLES REPAIR	LIGHT LINE REPAIR	ELECTRICAL SYSTEM	Battery-generator-starter-alternator-regulator specialist	List of tasks	Tasks common to ELECTRICAL SYSTEM	Tasks common to LIGHT LINE REPAIR	Tasks common to HEAVY DUTY VEHICLES REPAIR
			Elec'l. wiring harness & diagram sp.	List of tasks			
			Power accessory specialist	List of tasks			
			Air conditioning service person	List of tasks			
		HEATING & AIR CONDITIONING SYSTEM	Air cond. compressor overhauler *	List of tasks	Tasks common to HEATING & AIR CONDITIONING SYSTEM		
			Climate control specialist *	List of tasks			
			Air conditioning diagnostic sp.*	List of tasks			
			Air conditioning installer *	List of tasks			
			Heater diagnostic specialist *	List of tasks			
			Heater core repair person *	List of tasks			
		COOLING SYSTEM	Cooling system service person	List of tasks	Tasks common to COOLING SYSTEM		
			Cooling & lubrication system sp.	List of tasks			
			Lubrication person	List of tasks			
		FUEL, EXHAUST, & LUBRICATION SYSTEM	Engine tune-up specialist	List of tasks	Tasks common to FUEL, EXHAUST, & LUBRICATION SYSTEM		
			Exhaust system installer	List of tasks			
			Fuel injection specialist	List of tasks			
			Pump and injector specialist	List of tasks			
			Supercharging and turbocharging specialist	List of tasks			
			Governor specialist	List of tasks			
			Fuel and air system specialist	List of tasks			
	SUPPORTIVE OCCUPATIONS	SUPERVISORY	Shop foreman	List of tasks	Tasks common to SUPERVISORY	Tasks common to SUPPORTIVE OCCUPATIONS	
			Service manager	List of tasks			
			Quality control inspector	List of tasks			
			Parts manager	List of tasks			
		LOGISTICS & MAINTENANCE	Car jockey or clean-up	List of tasks	Tasks common to LOGISTICS & MAINTENANCE		
			Service writer	List of tasks			
			Parts & accessories salesperson	List of tasks			

** These job titles did not appear on the original matrix but were added later.*

I	II	III	IV	V	VI	VII	VIII
DIVISION (PROGRAMS)	CATEGORY (CURRICULA)	SUBCATEGORY (COURSES)	JOB TITLE	TASK	SUBCATEGORY CORE	CATEGORY CORE	DIVISION CORE
HEAVY DUTY VEHICLES REPAIR	SUPPORTIVE OCCUPATIONS	LOGISTICS & MAINTENANCE	Service salesperson	List of tasks	Tasks common to LOGISTICS & MAINTENANCE	Tasks common to SUPPORTIVE	Tasks common to HEAVY DUTY VEHICLES
			Estimating person	List of tasks			
			Parts person	List of tasks			
TRUCK & AUTO BODY REPAIR	BODY & FRAME	FRAME	Frame & panel straightener	List of tasks	Tasks common to FRAME	Tasks common to BODY & FRAME	Tasks common to TRUCK & AUTO BODY REPAIR
			Welder	List of tasks			
		METAL	Sheet metal straightener & cutter	List of tasks	Tasks common to METAL		
			Dent filling specialist	List of tasks			
			Fiber glass specialist	List of tasks			
	TRIM & FABRICS	WEATHER-STRIPPING & FABRICS	Auto body maintenance person	List of tasks	Tasks common to WEATHER-STRIPPING & FABRICS	Tasks common to TRIM & FABRICS	
			Upholstery & weatherstrip spec.	List of tasks			
			Convertible top, fabric roofs, woodgrain specialist	List of tasks			
		GLASS & TRIM	Hardware specialist	List of tasks	Tasks common to GLASS & TRIM		
			Glass installer	List of tasks			
			Trim specialist	List of tasks			
	PREPARATION & PAINTING	BODY PREPARATION	Metal preparer	List of tasks	Tasks common to BODY PREPAR.	Tasks common to PREPAR. & PAINTING	
			Sanding specialist	List of tasks			
		PAINTING	Paint matching specialist	List of tasks	Tasks common to PAINTING		
			Masking person	List of tasks			
			Painter	List of tasks			
	SUPPORTIVE OCCUPATIONS	SUPERVISORY	Estimator	List of tasks	Tasks common to SUPERVISORY	Tasks common to SUPPORTIVE OCCUPATIONS	
			Parts manager	List of tasks			
			Shop foreman	List of tasks			
		LOGISTICS	Parts person	List of tasks	Tasks common to LOGISTICS		
			Clean-up person	List of tasks			

APPENDIX E

I	II	III	IV	V	VI
DIVISION/CATEGORY (PROGRAMS/CURRICULA)	SUBCATEGORY (COURSES)	JOB TITLE	TASK	SUBCATEGORY CORE	DIVISION/CATEGORY CORE
SMALL ENGINES REPAIR	MARINE	OMC & Mercury cruiser mechanic	List of tasks	Tasks common to MARINE	Tasks common to SMALL ENGINES REPAIR
		Evinrude & Johnson outboard mech.	List of tasks		
		Mercury outboard mechanic	List of tasks		
		Chrysler outboard mechanic	List of tasks		
		Rigger	List of tasks		
		Glass, wood, & fiber glass spec.	List of tasks		
		Boat mechanic (jets)	List of tasks		
	MOTORCYCLE	Honda motorcycle mechanic	List of tasks	Tasks common to MOTORCYCLE	
		Kawasaki motorcycle mechanic	List of tasks		
		Yamaha motorcycle mechanic	List of tasks		
		Indian motorcycle mechanic	List of tasks		
		Harley-Davidson motorcycle mech.	List of tasks		
		Suzuki motorcycle mechanic	List of tasks		
		Triumph motorcycle mechanic	List of tasks		
		BSA motorcycle mechanic	List of tasks		
	UTILITY IMPLEMENTS & ALL-TERRAIN VEHICLES	Small engine mechanic (gas)	List of tasks	Tasks common to UTILITY IMPLEMENTS & ALL-TERRAIN VEHICLES	
	SUPPORTIVE OCCUPATIONS	Parts person	List of tasks	Tasks common to SUPPORTIVE OCCUPATIONS	
		Service manager	List of tasks		
		Shop foreman	List of tasks		
		Salesperson	List of tasks		
		Parts manager	List of tasks		

APPENDIX C

SAMPLE PAGE OF SURVEY TWO:
EMPLOYMENT PATTERNS IN JOB TITLES

Company name _____

Address _____

Your title _____

Number of people holding job title:

____ Air conditioning systems sp.
____ Auto body maintenance sp.
____ Automatic transmission sp.
____ Automotive machinist
____ Battery-generator-starter-alternator-regulator sp.
____ Brake machinist
____ Brake shoe reliner
____ Car jockey or clean-up
____ Clutch specialist
____ Convertible top, fabric roofs, woodgrain spec.
____ Cooling & lubrication system specialist
____ Cooling system service sp.
____ Dent filling specialist
____ Differential specialist
____ Drive shaft repairer
____ Electrical wiring harness & diagram specialist
____ Emission control spec.
____ Engine diagnostic spec.
____ Engine machinist
____ Engine overhaul sp.
____ Estimator
____ Engine tune-up sp.
____ Exhaust system installer
____ Glass installer
____ Fiber glass sp.
____ Frame & panel straightening spec.
____ Front end specialist
____ Fuel & air system sp.
____ Fuel injection spec.
____ Hardware specialist
____ Heavy line mechanic
____ Hydraulic brake sp.
____ Light line mechanic
____ Lubrication person
____ Manual transmission specialist
____ Masking person
____ Metal preparer
____ Overdrive specialist
____ Paint matching spec.

APPENDIX D

SAMPLE PAGES OF SURVEY THREE:
TASK INVENTORY

BACKGROUND INFORMATION

(Please print all requested information.)

Name: _____

Address: _____

city *state* *zip code*

Sex: ____ Male ____ Female

Total time on present job: ____ Years ____ Months

Total time in career field: ____ Years ____ Months

Present position or job title: _____

Number of employees supervised: _____

Name of employer: _____

Employer's address: _____

_____ _____ _____
city *state* *zip code*

Please circle years of education completed.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Stop! Read this page before going further.

Have you completed the BACKGROUND INFORMATION section? Make sure before you continue with this procedure.

Procedure A--Checking tasks of present job

1. As you read each task in the duty-task section, pages 1 through 10, place a check (✓) beside each task that you perform in your present job. Put your check mark in the column *Done in present job*.

2. Do not confuse work you do yourself with work you supervise or work that you know how to do but do not do in your present job. Check only the tasks you do.

3. If a task that you perform is not listed anywhere in the duty area, write it in the blank space at the end of the duty..

4. DO NOT COMPLETE THE *Time spent* COLUMN AT THIS TIME.

5. Remember, at this time you are to complete only the column headed *Done in present job* for pages 1 through 10. Now, turn to page 1 and BEGIN. When you have reached the end of the questionnaire, please return to Procedure B below.

Procedure B--Rating time spent on tasks performed

1. Now you are to rate the relative amount of time you spend performing each task in each duty area. Relative *Time spent* means the total time you spend doing the task compared with the time you spend on each of the other tasks in the duty area.

2. Use a rating of "1" if you spend "very much below average" amount of time on a task. Use a rating of "2" for "below average" time; and so on, up to a rating of "7" if you spend "very much above average" amount of time on the task.

3. In each duty select the task which you spend the most time doing and give it the highest rating on the 7-point scale.

4. Now rate the remaining tasks you have checked in relation to the highest-rated task and proceed to the next duty.

5. Place your rating, according to the 7-point scale, in the *Time spent* column (refer to *Time spent scale* at the top of each page).

6. When you have completed all your ratings in the *Time spent* column of pages 1 through 10, you will have completed the Task Inventory.

7. Now, turn to page 1 and BEGIN your rating for the *Time spent* column.

TASK INVENTORY

Time spent scale

1--very much below average
2--below average
3--slightly below average
4--about average
5--slightly above average
6--above average
7--very much above average

Task statement	*Done in present job*	*Time spent*
PERFORM MAJOR ENGINE REPAIR		
1. Add oil & water to engine		
2. Adjust valves		
3. Adjust valve tappets & bridges (diesel)		
4. Clean carburetor		
5. Clean & check internal engine parts for wear, cracks, alignment		
6. Bore cylinders		
7. Clean engine externally		
8. Check engine compression		
9. Check for vacuum air leaks		
10. Install valves		
11. Install connecting rods		
12. Diagnose valve train & head malfunctions		

Time spent scale

1--very much below average
2--below average
3--slightly below average
4--about average
5--slightly above average
6--above average
7--very much above average

Task statement	*Done in present job*	*Time spent*
13. Disassemble engine		
14. Drain oil & water from engine block & head		
15. Install pistons		
16. Grind rocker arm end		
17. Grind valves		
18. Hone connecting rod & correct bearing fit		
19. Hone cylinders		
20. Inspect &, if necessary, recondition camshaft		
21. Inspect &, if necessary, replace camshaft bearings		
22. Inspect &, if necessary, recondition crankshaft		
23. Inspect &, if necessary, replace crankshaft bearings		
24. Recondition valve seats		
25. Recondition valves		
26. Cut ridge out of cylinder		
27. Resurface cylinder head		
28. Visually inspect gaskets & seals for leaks		
29. Install freeze plugs		
30. Install new crankshaft sprocket		
31. Install new cylinder sleeve		
32. Recondition ring grooves & install new piston rings		
33. Install timing gears & chain		
34. Install new valve guides		

APPENDIX E

ADVISORY COMMITTEE

Automotive Working Advisory Committee

Mr. Gary Hill
Hill's College Standard Service
Indianapolis, Indiana

Mr. Gary Roudebush
Foxworthy Ford
Indianapolis, Indiana

Mr. Bill Young
Dan Young Chevrolet, Inc.
Indianapolis, Indiana

Mr. Bob Howell
Indiana Vocational Technical College
Cumberland, Indiana

Mr. Marion Stapleton
Lincoln Tech.
Noblesville, Indiana

Mr. Warren Dunn
Carmel Auto Parts
Carmel, Indiana

continued on next page

Auto Body Working Advisory Committee

Mr. Keith Passwater
Passwater's Body Shop
Indianapolis, Indiana

Mr. George Mack, Jr.
Ben Davis High School
Indianapolis, Indiana

Air Transportation Working Adivsory Committee

Mr. Cliff Scott
John Marshall High School
Indianapolis, Indiana

Mr. Ray Paschke
Van's Aviation
Terry Airport
Zionsville, Indiana

BIBLIOGRAPHY

Borcher, S.D. & Leiter, P.B. *Automotive mechanics occupational performance survey, interim report.* Columbus, OH: The Ohio State University, The Center for Vocational and Technical Education, March 1973.

Frantz, N.R. *Individualized instructional systems for vocational and technical education: a series of instructional models.* Athens, GA: Vocational Instructional Systems, 1974.

Frantz, N.R. Inservice education for individualizing instruction in multi-occupational programs. *Theory into practice: inservice programs in vocational education,* 1975, *14*(1), 32-38. Columbus, OH: The Ohio State University, College of Education.

Gagne, R.M. *The conditions of learning.* New York: Holt, Rinehart & Winston, 1965.

West, B.R. *A survey to determine occupational curriculum emphasis in Carmel Clay Schools.* Unpublished manuscript, November 1974.

West, B.R. *Task analysis for performance based vocational education.* Terre Haute, IN: Indiana State University, Indiana Curriculum Materials Center, 1976.

West, B.R. & Brannock, D. *The development of a compentency based multi-occupational curriculum for flexible programming of the transportation cluster, final report.* Indianapolis, IN: State Board of Vocational and Technical Education, 1976. (An earlier, more detailed version of this Information Series Report #4).

OTHER

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- *Employment Patterns and Earnings of Secondary School Vocational Graduates*, written by William B. Richardson and Joan R. McFadden. Explores the relationships between vocational graduates' training programs, jobs, and incomes during a maximum period of one year and eight months after program completion. 1977, 31 pp. (Report Series No. 1).

- *Vocational Programs in Indiana for the Disadvantaged and Handicapped*, edited by Elaine G. Eigeman. Abstracts and synthesizes current Indiana vocational programs for special needs students in the special projects funding category. 1977, 64 pp. (Report Series No. 2).

- *The Public's Perception of Secondary Vocational Education in Indiana*, written by Betty A. Sawyers. Studies the general image of vocational-technical education as represented by a statistical sampling of respondents from five categories. 1977, 49 pp. (Report Series No. 3).

* * * * * *

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